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To: Board of Forestry and Fire Protection

From: Kevin Conway, Staff Forester

Subject: Forest Fire Prevention Pilot Project Exemption Slash Requirements

Chairman Gilless and Members of the Board,

The Board spent considerable time at the initial hearing for the Forest Fire Prevention Pilot Project Exemption (Pilot Project) debating the relative merits of increasing the maximum post-harvest slash depth from 9 to 18 inches. Two of the competing factors to be balanced in this decision are the economic efficiency of the project influencing the number of acres treated and the projects intended purpose to reduce the rate of fire spread, duration and intensity, fuel ignitability, or the ignition of tree crowns. This document provides further background material for the continuation of that discussion.

The subject of fuel reduction treatments has been given a lot of attention in recent years, much of it targeted at the management of publicly owned lands. There are many peer reviewed papers that evaluate the use of both mechanical and prescribed fire treatments to modify fuel characteristics such as quantity, size, composition, and horizontal and vertical distribution. The general findings seem to indicate that the most effective treatments use mechanical methods to address ladder and canopy fuels and prescribed fire to address surface fuels (Agee, 2005; Graham, 2004; Ritchie, 2005; Vaillant, 2009;). It should be noted that much of the literature is based on modeled fire behavior and are most relevant to the drier forest types away from the coastal ranges.

Effective fuel reduction treatments to modify future fire behavior tend to share three general traits: (1) reduction of surface fuels, (2) increase the height to live crown, and (3) reduction of canopy bulk density (Agee, 2005; Graham, 2004). The composition and distribution of surface fuels effect flame length, and residence time, among other factors. Tree canopies are susceptible to torching through both direct flame impingement or sustained exposure to high heat. Fuel beds conducive to long residence times can also injure or kill trees by damaging the cambium and roots. Increasing the live crown height effectively requires greater flame lengths to cause a tree to torch. Reducing the canopy bulk density decreases the potential for active crown fire to occur. The Pilot Project includes requirements to address all three of these concerns.

The question the Board could not come to unanimous resolution on is whether increasing the maximum post harvest surface fuel depth to 18 inches struck an appropriate balance between modifying future wildfire behavior and the economic efficiency of the projects. Balancing these interests is a policy question not addressed in the readily available peer-reviewed literature. Below is some brief background information on the economics of fuel reduction, the resource protection performance of various surface fuel treatments, and expected fire behavior of various representative fuel types that may prove useful for this conversation.

The economics of projects allowable under the Pilot Project are highly dependent on forest stand characteristics, harvesting method, the degree and methods for treating surface fuels, and access to commercial markets. In general, stands with low existing fuel loading and high proportions of large diameter stems that can be mechanically felled, whole tree yarded, and have economic access to a biomass facility will be more profitable (or likely to break even) than treating stands that do not have those characteristics. Hartsough, et. al. (2008) found that mechanical treatments had higher gross costs and more predictable results than fire only treatments. The net costs, or in some cases benefit, after mechanical treatment were sensitive to stumpage prices of the merchantable timber. Biomass was found to have only marginal economic benefits in locations where markets existed. These treatments were all on publicly owned lands and may not be directly comparable to projects on private lands under the Pilot Project.

A number of studies model the expected mortality of trees after various levels of fuel reduction treatments. Vaillant et al. (2009) modelled pre and post harvest fire behavior in stands receiving various combinations of mechanical and prescribed fire treatments. This study found mixed results in mechanically treated stands. All three sites showed some susceptibility to passive or conditional crown fire post harvest under gusty wind conditions, with two of those sites showing reduced amounts. The overall conclusion was that both treatments led to reduced potential fire behavior with 90^{th} percentile and gusty wind speeds.

Agee and Skinner (2005) attempted to draw some conclusions from observing fire behavior of wildland fires that burned through previously treated stands. They found that the fuel treatment applied, the scale of the treatment, and the time since treatment all played a role in influencing fire behavior effects. In general, treatments that added to surface fuels instead of treating them tended to exhibit higher fire severity than adjacent stands that were untreated or included reduction of surface fuels.

The depth and distribution of surface fuels in the stands analyzed is unclear which makes it difficult to draw conclusions about the proposed maximum 18 inch surface fuel depth under consideration. Weather conditions and local topography also have a large effect on wildland fire severity given constant fuel beds. The fuel modelling can show relative differences in treatments by holding these variables constant but cannot predict actual fire behavior of an uncertain future wildfire event. Graham et. al (2004) recommends that treatments should strive to reduce the likelihood of crown fire and other fire behavior under most weather conditions. They also caution that isolated uncoordinated treatments are generally ineffective in reducing wildfire extent and severity compared to coordinated and focused landscape level treatments.

Fuel bed depth is used in standard fire behavior fuel models that are useful for predicting surface fire behavior. Selected pages from the Scott and Burgan (2005) document are attached. The first couple of pages include the description of the qualitative terms used to describe dead fuel moisture, rate of spread and flame length. This is followed by the key for identifying your particular fuel type and descriptions of fuel type TL4, TL5, SB1, SB2, and SB3 that staff identified as most closely representative of post harvest surface fuel conditions from the Pilot Project. Notice that the SB fuel classes include a slash depth of less than, equal to, or more than one foot. Each page includes predicted flame lengths and rates of spread expected in with different fuel moistures and midflame wind speeds. The last page of this document is a fire characteristic chart (Andrews, 1982) that includes some general rules of thumb for fire behaviors where ground forces can be committed to suppression activities. The curves include both flame length and rate of spread so you can compare this to expected fire behavior of each model.

The intensity of surface fuel reduction required by the existing Forest Fire Prevention Exemption has been identified as an economic barrier to the widespread use of this exemption for performing the intended fuel reduction work throughout the state. Anecdotal evidence suggests that it is common practice in commercial timber harvesting operations to burn at least some portion of the project created fuel at centralized landings or dispersed piles throughout the operational area. This would suggest that surface fuels present post harvest would be discontinuous and would not be modelled well by making only one set of assumptions as to its composition and distribution. The original proposal by the proponent of the 18 inch standard also included a maximum 25 tons per acre of surface fuels which may have been getting at a standard for mandating this discontinuity of surface fuels.

In conclusion, staff did not identify any papers that directly addressed surface fuel reduction to either a 9 or 18 inch maximum height. Given the diversity of forest characteristics throughout the state it is difficult to predict the intensity of treatment required, if any, to meet either of these standards post harvest. There is general agreement amongst the scientific literature that the most effective fuel reduction treatments address surface fuels, height of live crown, and canopy bulk density. The Pilot Project addresses all three components to some degree. It is left to the Board's discretion the degree of surface fuel reduction necessary to further the State's goal of increasing the number of acres treated for fuel hazard reduction through the Pilot Project.

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